

REMARKS

Claims 1-17 are pending in the application. Claims 1 and 10 were amended to more particularly point out and distinctly claim the inventions of claims 1 and 10. Support for the amendments to claims 1 and 10 can be found in at least page 15, line 24, page 31, lines 10-14 and page 32, lines 2-4 of the present specification. Therefore, no new matter has been added.

Specification

The specification was amended to address typographical and grammatical errors. Also, element numbers 30, 31, 32 were added to the specification in the paragraph beginning on page 44 at line 17. Support for these amendments can be found in at least Figure 10 of the present specification. Element number 43 was added to specification in the paragraph beginning on page 41 at line 10. Support for this amendment can be found in at least Figure 9 of the present specification. Element number 46 was replaced with element number 40 in the paragraph beginning on page 44 at line 17. Support for this amendment can be found in at least Figures 9 and 10 of the present specification. Therefore, no new matter has been added.

Drawings

Figure 5 was amended to annotate the figure with the “H” interval reference as well as the position references “Z1”, “(Zk-2)”, “(Zk-1)”, “(Zk)”, “(Zk+1)”, “(Zk+2)” and “(Zn)”. Support for these amendments can be found in at least the original Figure 5 and page 30, lines 5-14 of the present specification. Therefore, no new matter has been added.

For at least the reasons set forth below, withdrawal of all outstanding objections and rejections is respectfully requested.

Objection to the Specification

The Examiner has objected to the specification due to certain informalities. The specification was amended to address the issues pointed out by the Examiner as well as to address other minor errors. Therefore, Applicants respectfully request that the Examiner reconsider and withdraw the objection to the specification.

Objection to the Drawings

The Examiner has objected to the drawings. As discussed above, Figure 5 was amended to add the references “H”, “Z1”, “(Zk-2)”, “(Zk-1)”, “(Zk+2)” and “(Zn)”. The representations of the “Z” series references are consistent with the existing representations of the “P” series references. Also as indicated above, references 30, 31, 32 and 43 were added to the specification and element number 46 was replaced with element number 40 in the specification regarding the description of Figure 10. Therefore, Applicants request that the Examiner reconsider and withdraw the objection to the drawings.

Prior Art Rejections

Claims 1-6 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,398,732 (Brock-Fisher *et al.*, hereafter “Brock-Fisher”) in view of U.S. Patent No. 5,411,028 (Bonnefous).

Claims 7 and 8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Brock-Fisher in view of Bonnefous and further in view of U.S. Patent No. 6,030,344 (Guracar *et al.*, hereinafter “Guracar”).

Claims 10-15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Brock-Fisher and further in view of Bonnefous.

Claims 16-17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Brock-Fisher in view of Bonnefous and further in view of Guracar.

Applicants respectfully traverse these rejections.

1. Patentability of independent claims 1 and 10 over Brock-Fisher

Claim 1 reads, in part, as follows (underlining for emphasis):

a fluid determining section for determining a fluid portion in the object to be measured in accordance with the phase-detected signal; and

an image data generating section for generating image data for two-dimensionally image-displaying the deformation amounts and/or elastic moduli of the object to

be measured in a region other than the fluid portion by using the information determined by the fluid determining section.

Claim 10 reads, in part, as follows (underlining added for emphasis):

- (D) determining a fluid portion in the object to be measured in accordance with the phase-detected signal; and
- (E) using information determined by the fluid determining section and thereby generating image data for two-dimensionally image-displaying the deformation amount and/or elastic module of the object to be measured in a region other than the fluid portion.

The present specification discloses a fluid determination section 9 that determines a fluid portion in a region (object) to be measured by an ultrasonic diagnostic apparatus 50. The fluid determination section 9 receives a signal component having a large Doppler shift in the real-part signal and imaginary-part signal divided in the phase detecting section 6 from the first filter 7 and the second filter 8 of the filter section 71 (thus in accordance with the phase-detected signal). See Figures 1-4 and page 24, lines 3-10 of the present specification. The fluid determination section 9 obtains a flow rate at each position in a region to be measured by using the color Doppler method. The fluid determination section 9 can specify the fluid portion in the region to be measured in accordance with the amplitude information by the power Doppler method. The fluid determination section 9 sends positional information of the fluid portion to the image data generating section 72. See page 24, lines 11-17 of the present specification. When the fluid determination section 9 uses the color Doppler method, the image data generating section 72 is able to generate a color flow image colored in accordance with the moving direction and flow rate of the fluid. See page 26, lines 23-26 of the present specification.

The Examiner states that Brock-Fisher, in column 4, lines 38-48, teaches a fluid determining section for determining a fluid portion in the object to be measured in accordance with the phase-detected signal. See page 5 of the outstanding Office Action. Brock-Fisher discloses a coherent phase comparative procedure 70 that compares the echo signal returns of two transmit events where each event is transmitted at a different incident signal power levels, P1 and P2, and wherein P2 is greater than P1. The coherent phase comparative procedure 70 creates a difference signal by comparing (subtracting) the values of the two return signals in

segments of the time sequence in which the echo return signals were measured. If the difference signal exhibits a phase relationship that is out-of-phase with the echo return signal, it is concluded that the boundary 22 between the tissue area 10 and blood area 12 has been reached. If the difference signal exhibits a phase relationship that is in-phase with the echo return signal, it is concluded that the boundary 22 has not been reached. The coherent phase comparative procedure 70 reports the first time segment to show the phase change relationship indicating the time point at which the boundary between tissue and blood is detected. This time segment of the phase change signal is related to the remaining signals of the ultrasound image, allowing the position of the boundary to be determined. See Figures 1-5 and column 2, lines 55-67 and column 4, lines 11-48 of Brock-Fisher.

Thus, in the section identified by the Examiner, Brock-Fisher merely discloses a coherent phase comparative procedure 70 which determines the location of the boundary layer 22 between the tissue region 10 and the blood region 12 and does not disclose a fluid determining section for determining a fluid portion in the object to be measured in accordance with the phase-detected signal as disclosed in the present specification. Nowhere in Brock-Fisher is a procedure or apparatus disclosed that determines the fluid region in its entirety (the positional information of the fluid portion) or a flow rate at each position in a region or the moving direction and flow rate of the fluid.

Neither Bonnefous nor Guracar compensate for the deficiencies of Brock-Fisher. Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claims 1 and 10.

2. Patentability of independent claims 1 and 10 over Bonnefous

Claim 1 reads, in part, as follows (underlining added for emphasis):

a computing section for obtaining the velocities of the object to be measured at a plurality of measuring positions of the object to be measured from the phase-detected signal and obtaining the deformation amounts and/or elastic moduli in at least one micro-region from the velocities and in a radius direction of the blood vessel, the micro-region defined by a portion of the object to be measured between at least two of the measuring positions;

Claim 10 reads, in part, as follows (underlining added for emphasis):

(C) obtaining the velocities of the object to be measured at a plurality of measuring positions of the object to be measured in accordance with the phase-detected signal and obtaining the deformation amounts and/or elastic moduli in at least one micro-region from the velocities and in a radius direction of the blood vessel, the micro-region defined by a portion of the object to be measured between at least two of the measuring positions;

The present specification discloses a method to measure the deformation amounts and/or the elastic moduli in the radial direction of an object to be measured, the object including a blood vessel, in a plurality of micro-regions. The micro-regions are defined by the those portions of the object to be measured (the blood vessel) between the plurality of measurement positions, such as Pk and Pk+1 for example, where the acoustic beams are directed. The deformation amounts and the elastic moduli are determined from the displacement amounts, for example dk(t) and dk+1(t) of the measurement positions Pk and Pk+1, with reference to the acoustic line 22 that serves as the central axis of the ultrasonic beam. Thus the deformation amounts and elastic moduli are obtained in at least one micro-region from the velocities and in a radius direction of the blood vessel. See Figure 5 and page 30, line 5 to page 32, line 14 of the present specification.

Bonnefous discloses a method to determine the elasticity of an artery based on the change of the diameter of the artery. The change in diameter is converted into the change in the circumferential length of the artery by assuming that the artery has a true circular cross-section (using a mean radius, assuming small variations in the radius of the portion of the blood vessel being measured). The elasticity in the circumferential direction is calculated based on the change in the circumferential length. Considering the assumption of the true circular cross-section, the calculated circumferential elasticity is an average elasticity. See col. 7, lines 9-20, col. 13, lines 45-60, col. 15, line 66 to col. 16, line 5, col. 17, lines 14-15 and col. 19, line 10 to col. 20, line 10 of Bonnefous. Therefore, Bonnefous does not disclose obtaining deformation

amounts and/or elastic moduli in at least one micro-region from the velocities and in a radius direction of the blood vessel. The Examiner states that Bonnefous discloses obtaining velocities of the object to calculate deformation (in col. 1, line 45 to col. 2, line 5), or the elastic moduli (in col. 3, line 47-50). See pages 5 and 10 of the outstanding Office Action. As discussed previously, Bonnefous does not disclose obtaining deformation amounts and/or elastic moduli in at least one micro-region from the velocities and in a radius direction of the blood vessel but merely discloses a method for determining an average elasticity in the circumferential direction of a blood vessel.

Neither Brock-Fisher nor Guracar compensate for the deficiencies of Bonnefous. Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claims 1 and 10.

3. Patentability of dependent claims over the cited prior art

The dependent claims are believed to be patentable over the applied references for at least the reason they are dependent upon patentable base claims and because they recite additional patentable elements and steps. Accordingly, Applicants request that the Examiner reconsider and withdraw the rejections to claims 2-9 and 11-17.

Conclusion

Insofar as the Examiner's rejections and objections were fully addressed, the present application is in condition for allowance. Issuance of a Notice of Allowability of all pending claims is therefore requested.

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Respectfully submitted,

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